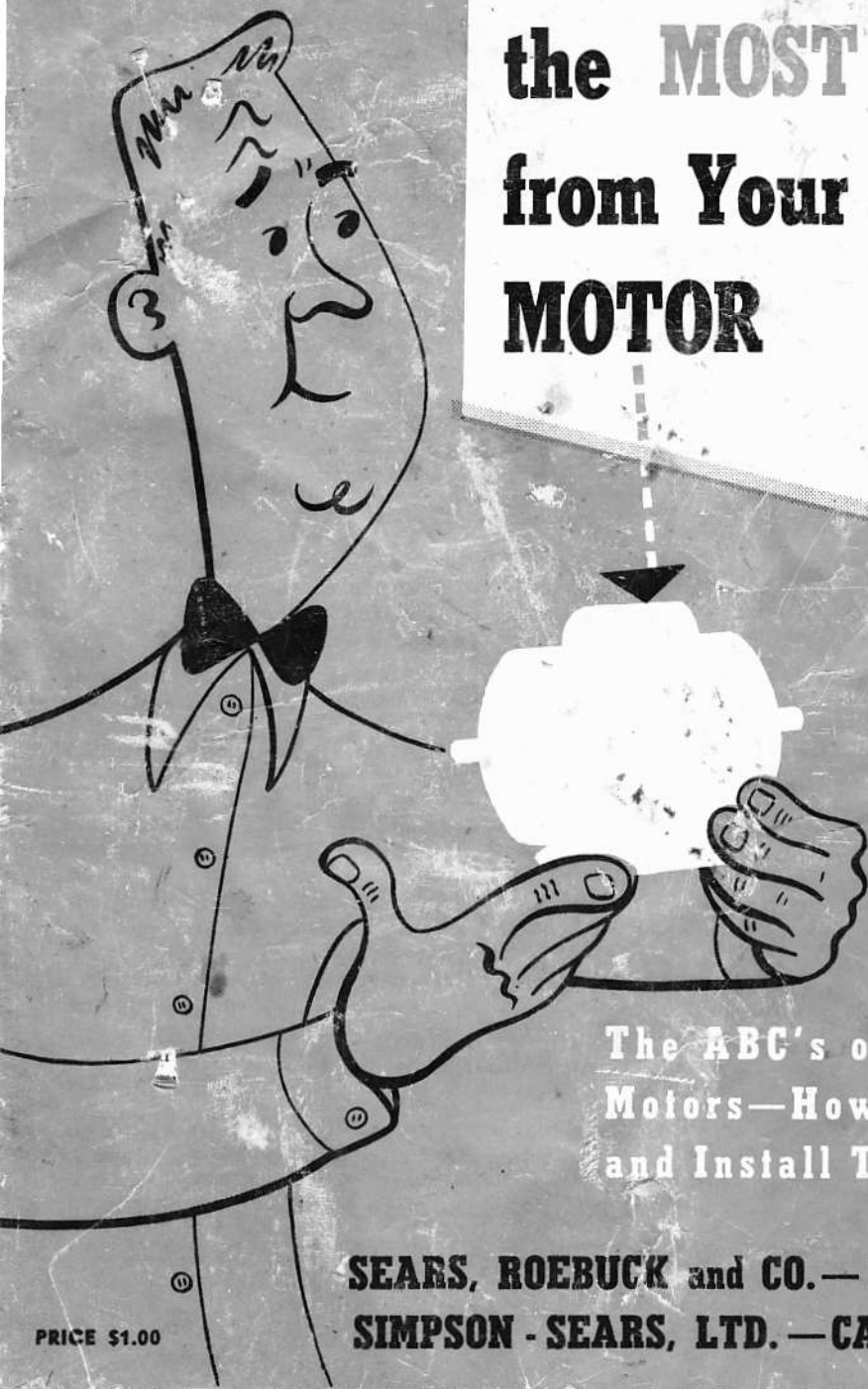


A CRAFTSMAN HANDBOOK

CAT. NO. 9-1900

How to get the **MOST** from Your **MOTOR**



The ABC's of Electric
Motors—How to Choose
and Install Them

SEARS, ROEBUCK and CO.—U. S. A.
SIMPSON - SEARS, LTD. — CANADA

PRICE \$1.00

MOTORS are Better than Muscles



Yesterday, every household, farm and production task had to be done the hard way — by physical labor. Jobs like heating and refrigeration, sharpening tools, carpet sweeping, loading a silo — even the simple necessity of drawing water — all required muscles . . . and lots of your own energy, to get them done.

Today, silent, efficient dependable electric motors do all these chores — and hundreds more. Motors are used for just about every kind of work: Garbage disposal, dishwashing, polishing — and heavy-duty labor and production jobs too numerous to mention. Count the electric motors serving you. You'll be surprised at the number.

IMPORTANT FEATURES

SPLIT-PHASE MOTORS

These motors are built for top economy and general use on *easy-starting loads* such as light power tools, office machines, small ventilating fans, etc. All are for 110-120 V, 60-cycle AC; are furnished with an 8-foot cord and plug.

STANDARD MODELS: Two sizes: $\frac{1}{4}$ and $\frac{1}{3}$ HP. Single-end shaft; precision bronze bearings. For use in horizontal positions only.

HEAVIER-DUTY MODEL: A $\frac{1}{3}$ HP with superior (more than double) overload capacity. Double-end shaft; ball bearings. For use in any position.

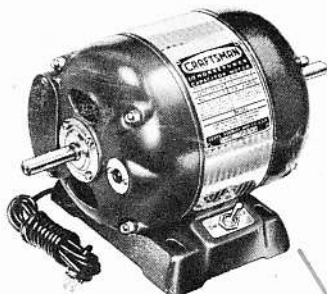
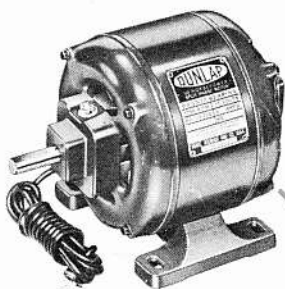
CAPACITOR TYPE MOTORS

These are similar to split-phase motors but have capacitors added so that they will take *medium-starting loads* (approx. 50% heavier than split-phase motors of equal ratings), such as most home workshop tools, paint sprayers, refrigerators, stokers, etc.

ECONOMICAL APPLIANCE TYPE: Rugged $\frac{1}{3}$ HP. Single-end shaft; precision bronze bearings. For 115 V, 60-cycle AC; horizontal position only.

POWERFUL SHOP TYPE: Sizes $\frac{1}{3}$, $\frac{1}{2}$ and $\frac{3}{4}$ HP. Double-end shaft; ball bearings; ON-OFF switch; thermal overload protector; cord and plug. Operate in any position. For 110-120 V, 60-cycle AC.

HEAVY-DUTY MILL TYPE: Sizes $\frac{1}{2}$ to $1\frac{1}{2}$ HP. Same features as shop type, but heavier in construction and with superior overload capacity. For 115 or 230 V, 60-cycle AC.



but You Should Know How to Use Them



As wonderfully designed and miracle-working as most motors are, there are limits to the size of load that each can carry — to the neglect and abuse that each can suffer without damage. You don't expect too much of your muscles. It's just as unreasonable to ask more of a motor than it is designed to give.

Before putting your new motor to work, do it — and yourself — the favor of learning something about it. Read this booklet. It tells you how to judge whether or not you have the right motor for your job. It also tells you how to install and maintain your motor so that it will serve you faithfully and tirelessly.

OF SEARS' MOTORS

Most Sears' general-purpose motors are available for either clockwise or counterclockwise rotation, as wired when purchased. However, all these general-purpose motors can easily be reversed by following simple directions furnished with each.

REPULSION-INDUCTION AND 3-PHASE MOTORS

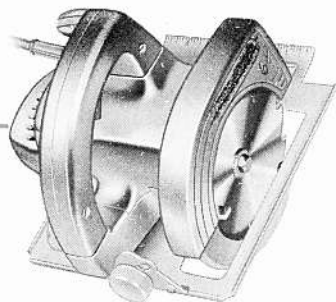
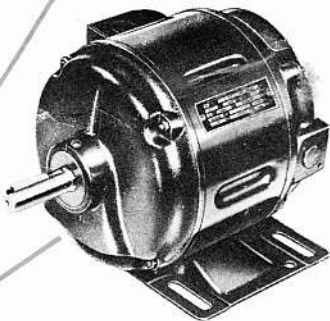
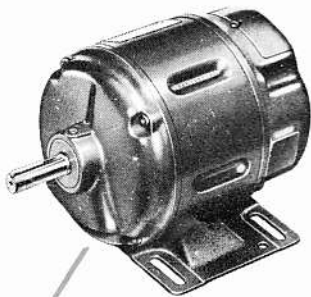
The finest motors built, each is designed for *heaviest starting loads* and constant use, with great overload capacity.

R-I MOTOR: For single-phase, 115 or 230 V, 60-cycle AC. Sizes $\frac{1}{3}$ to 5 HP. Single-end, keyway shaft; ball bearings. Excellent for farm and R.E.A. lines, low-voltage lines, and extreme weather conditions.

3-PHASE MOTOR: For 3-phase, 220 or 440 V, 60-cycle AC (usually, only in industrial areas). Sizes $\frac{1}{2}$ to 5 HP. Single-end, keyway shaft; ball bearings. Provides the most economical operation of any type.

POWER TOOL WITH INTEGRAL MOTOR

Portable power tools have built-in universal AC: DC Motors. These are extremely compact and run at high speed. Each is designed specifically for the job that the tool is intended to do.



ELECTRICAL TERMS USED IN DESCRIBING MOTORS

Commercial electricity is manufactured by Power Company *generators*, and transported by wires in the form of *current*. And there are different kinds. *DC (direct current)* electricity is like a spinning wheel that revolves *always in one direction*; *AC (alternating current)* is like a pump handle that *travels back and forth*. Both currents travel at 186,000 miles per sec. — but AC can be made to change direction with varying rapidity (*frequency*). If it changes 120 times per sec. (so that it "goes out" and "returns to" the generator 60 times per sec.) we call it 60-cycle AC. Most AC is now 60-cycle, though 25- and 50-cycle are occasionally used.

Each TYPE of MOTOR

Motors can be classed in 3 major groups: *Direct Current (DC)*, *Alternating Current (AC)*, and *Universal (AC: DC)* — depending on the type current on which they will run.

DIRECT-CURRENT MOTORS

The earliest kind, DC motors are still used for some purposes, and where only DC power is available.

In a simple, *Series Wound DC motor*, current "flows" through the wires of a *field* (stationary part) then through wires on an *armature* (rotating part). It is conducted to the armature by *brushes* which rub a *commutator* on the shaft. In "flowing" it makes the field and armature into magnets having *north (N) poles* and *south (S) poles* with like poles adjacent. But *like poles* repel each other — so the armature rotates 180° to place the *unlike poles* (which attract each other) adjacent. However, each time the armature rotates 180° the commutator reverses current flow through the armature so that adjacent poles are again alike. Hence the armature continues to rotate.

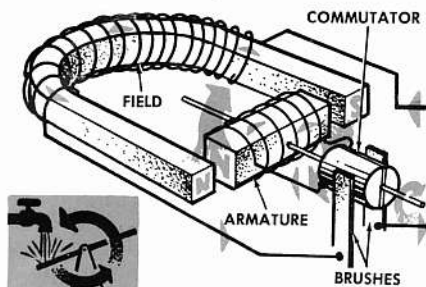
The above motor will vary in speed with variations in the voltage and the load placed on it, but is powerful at starting. There are also *Shunt-Wound* and *Compound-Wound* DC motors.

ALTERNATING-CURRENT MOTORS

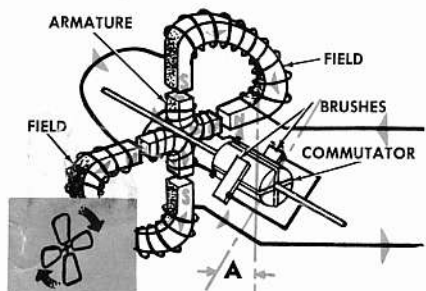
AC motors are of 4 basic types, but for practical purposes we will consider only the *Repulsion* and *Induction* types. The other 2 are: *Series-Wound* (see Universal Motors), and *Synchronous* (used mostly for clocks).

REPULSION MOTOR

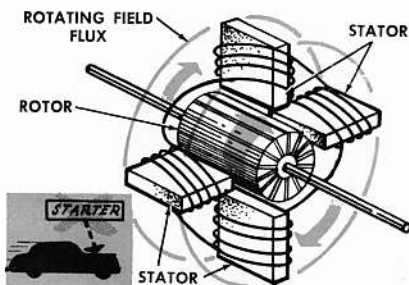
This is like the Series-Wound DC motor — except that the brushes are connected together, instead of in series with the field. When the field is excited (current turned on), a current (and resulting N and S poles) is created in the armature by an electrical process called *induction*. The angle (*A* in illus.) between the brushes and field determine the no-load speed of the motor; performance speed varies the same as in the Series-Wound DC motor. Motor has a "powerful" starting ability.



SERIES-WOUND DC TYPE



AC REPULSION TYPE



AC INDUCTION TYPE
(Already Running)

A *circuit* is an unbroken "path" from the generator to the device using electricity, and back to the generator. This path is formed by *conductors* (usually wires). The amount of current "flowing" in a conductor at any instant is measured in *amperes* (*A* or *amps*) like water is measured in gallons. The force that propels it is measured in *volts* (*V*) like water pressure is measured in ft.-lbs. $V \times A = \text{Watts (W)}$, the unit for measuring electrical power delivered by a current. Power companies sell current by *Kilowatt Hours*, meaning the equivalent of so many hours of work at the rate of 1,000 W per hour.

In general: The power company supplies your premises by means of 2 or 3 wires. If you have 2

wires, chances are your supply is 115 (approx.) V, 60-cycle *single-phase* AC (meaning that all the current "marches" back and forth in the wires like a single file of troops). If there are 3 wires (especially in a city), you probably have a choice of 115 V or 230 V, 60-cycle, single-phase AC, depending upon which 2 wires you use. However, you may have 3-phase AC (usually at 230 V or 440 V, 60-cycle), meaning that there are 3 single-phase currents (like 3 files of troops marching back and forth, but each line changing direction $\frac{1}{3}$ of a cycle after another). In this case you will use *all 3 wires*. There is also 2-phase AC, also requiring 3 wires.

is designed for a purpose.

INDUCTION MOTOR

When the Repulsion motor (p. 4.) is running, a *flux* (magnetic field) is created by the field magnets which will induce the needed polarity (existence of N and S poles) in the rotating part, without the aid of brushes and a commutator. These parts can be omitted, and we have an Induction motor — and the armature is now called a *rotor* and the field is called a *stator*. Some rotors are wire wound; some (*squirrel-cage type*) simply have a series of copper bars embedded in a soft iron core, or are diecast aluminum.

The Induction motor has big advantages over other types: It will run practically without loss of speed due to current or load variations, up to the limit of capacity; and is very efficient. But it is not self-starting, so various *starting devices* are used:

A *SPLIT-PHASE* motor is an induction motor with a *starting winding* added to the stator, and arranged to be cut out by a centrifugal switch after the motor is started.

A *CAPACITOR* motor is a Split-Phase motor with a *condenser* added to reduce the starting current required and increase the starting *torque* (power).

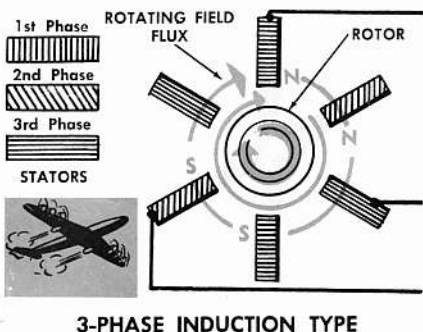
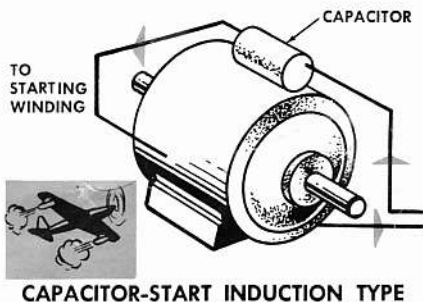
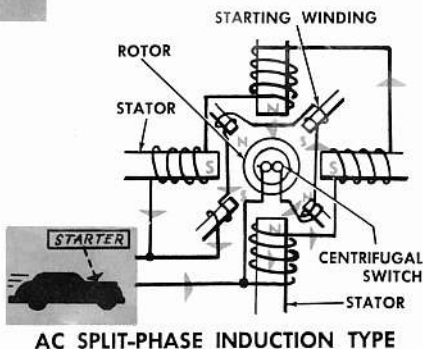
A *SHADED-POLE* motor is a variation of the Split-Phase motor, without means of cutting out the starting device. It has less starting power and is less efficient in operation.

A *REPULSION-INDUCTION* motor is a Repulsion motor with a centrifugal switch to cut out the brushes after starting. In some types the brushes are also lifted off the commutator. This motor has all the best features of both types, starting as a Repulsion motor but running as an Induction motor.

A *3-PHASE* motor is "strictly" an Induction type. The fact that it uses 3-phase current (p. 4) provides a very powerful "starting push", and no devices are required.

UNIVERSAL MOTORS

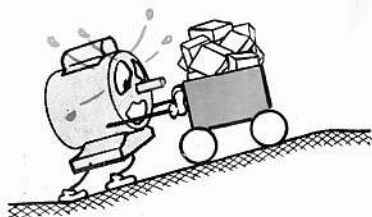
These are really Series-Wound AC motors designed to perform well on both single-phase AC and DC. Because they will develop destructively high speeds under no load, they are usually used as integral motors in hand power tools or for specific applications where they will be under constant, pre-determined load.



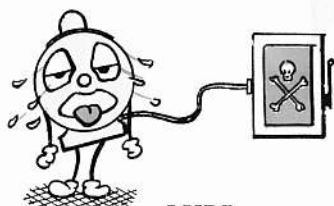
What to Consider WHEN SELECTING YOUR MOTOR



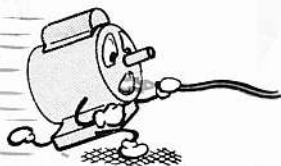
HORSEPOWER (HP)



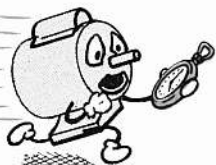
TYPE OF CURRENT



AMPS - STARTING AND RUNNING



RPM AND DIRECTION OF ROTATION



RUNNING TIME AND TEMPERATURE RISE

If you are buying a motor to run new equipment, pay attention to the equipment manufacturer's recommendations. If you are replacing an old motor, learn the specifications of this old motor. In any case, always buy a motor equal to or better than called for — never one that has less power or inferior qualities. NOTE: If replacing a gasoline engine that has *easily* carried its load, you can generally use an AC motor rated at only 60-75% of the gas engine HP.

ELECTRICAL CHARACTERISTICS

The important electrical characteristics of a motor are printed on the motor nameplate, or are told to you in manufacturer's specifications (on which you can rely if the manufacturer is reliable).

If you push a car from a standing start on a level road, it takes an extra effort to start the car, then a smaller (but steady) effort to keep it rolling — with occasional spurts of extra effort (again) as the car rolls over bumps. It's the same with a motor attached to a load. Therefore a motor is said to be capable of so much *starting torque* (push), so much *running torque* and so much *overload torque*. *Breakdown torque* (its maximum push, beyond which it stalls) is also used.

Motor torque is measured by horsepower. The *rated HP* of a motor is its running torque, at *normal running speed*. That is, a motor rated at 2 HP can pull with the strength of two horses — for all of its life. At starting, or when required to give an extra spurt of effort, it is said to be *overloaded* — and the safe *overload capacity* of a motor is usually stated as so many (say 2 or 5) times the rated HP. But this overload capacity is only a *temporary* one because a motor heats up rapidly, and may burn out, if *overloaded too long or too much*.

It is very important to most motors whether you connect them to DC or AC, whether AC is single-, 2- or 3-phase — and whether the voltage is 115 or some other amount. Each is generally designed to run on a certain current with voltage of approximately a certain amount. Actually, there is a loss of voltage in power lines and Power Companies cannot always deliver exact voltages. Therefore, most motors are made to allow 10% voltage variation without harm; but the voltage should not be allowed to drop more than this (except that R-1 and 3-Phase Motors can stand greater drops).

"Feeding" a motor a wrong current or wrong voltage will, at best, reduce its efficiency and life — at worst, can burn it up. It is particularly dangerous to an Induction motor to connect it to a DC line.

Just as you need a certain amount of food to keep going, so a motor needs a continuous supply of amps. And like you, when it works hardest, it needs an extra amount. Therefore, we say that a motor requires *so many amps at starting* (or for temporary overloads), and *so many* (generally only $\frac{1}{3}$ to $\frac{1}{4}$ of the starting amps) *for normal running*.

If you connect to the right power supply you needn't worry about having enough amps; but you do have to think about the size wires you use between the power source and your motor (wires that are too small can't carry enough amps). When choosing these wires, be sure to have them big enough to *carry the starting amps*, not just the running amps.

Induction-type motors run at practically constant speed (unless so overloaded as to stall) — and each is therefore rated according to the rpm (revolutions per minute) which its shaft will turn. The two commonest are approx. 1725 and 3450 rpm. You can, of course, obtain higher or lower speeds at the equipment by using various pulley sizes or gears; but it is often inconvenient to change an arrangement already planned for you by the manufacturer. Therefore, it's best to get a motor with the recommended rpm.

For the same reason, you can avoid trouble by getting a motor that revolves in the right direction (clockwise or counterclockwise). However, this is not too important with Sears' motors as all can easily be reversed.

Though seldom indicated on a nameplate, you may have heard these terms. They refer to the "heating characteristics" of a motor. Every motor heats up as it runs (*temperature rise*). This rise is not critical unless a motor is overloaded too long — in which case it may overheat and burn out. Special purpose motors are sometimes built to run a while, then stop and cool a while — in which case *running time* is stated.

WHAT IS MEANT BY NEMA

N.E.M.A. means National Electrical Manufacturers' Association — the organization which coordinates the standardization of motor ratings and dimensions.

PHYSICAL CHARACTERISTICS

The physical characteristics of a motor (its size, shape, etc.) can be just as important as its electrical characteristics, if it must fit a certain space or drive a specifically designed piece of equipment. Some of a motor's physical characteristics are listed in catalog specifications — others must be observed by looking at the motor, and perhaps by taking measurements.

SIZE AND SHAPE

Obviously, if you have limited space in which to install your motor, size and shape are very important. Not only must you consider whether or not the motor will fit in — it's also important for it to *have room to "breathe"*. All motors require a free circulation of air, to keep from overheating. *Don't* squeeze one into a space so tight that it will "suffocate" in its own heat!

TYPE AND SIZE OF BASE

Different motors are provided with different types of mounting arrangements. Usually, you can adapt a motor to most any special mounting requirement (if there's room); but much time and trouble can be saved by getting a motor that will mount where you want it without alteration.

HEIGHT OF SHAFT

When considering the type of base, consider also the height at which the shaft sets above the base. If it is too high, you may have difficulty locating the motor so that it can be connected to your equipment.

KIND OF SHAFT END

Motor shafts come in different sizes ($\frac{1}{2}$ in., $\frac{3}{8}$ in., etc.) — and are of different types. For securing a pulley or tool to be driven by the motor, a shaft is generally slotted — for a key — or flattened (beveled) for use with set screws. Special shafts have detents (depressions for set screws), threads, holes (for pins), etc. If you don't have the right shaft, it's difficult to connect a motor to its load.

Some motors have a shaft at each end (instead of just one end) — which may be quite an advantage for certain purposes.

TYPE OF BEARINGS

The quality of the bearings used in a motor is not only important to the life and trouble-free running of the motor — it may also determine whether or not you can even use the motor. There are two general types of bearings: *Ball bearings*; and *bronze (sleeve-type) bearings*. Ball bearings are sealed in grease and, for most general purpose applications, may never need additional lubrication. Motors equipped with ball bearings may be mounted in any position. A bronze bearing motor, however, must be oiled — and should be mounted with the shaft horizontal, so that oil cups will be upright and will retain the oil.

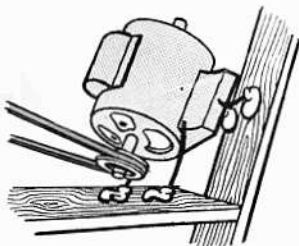
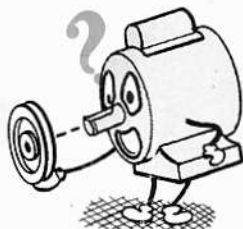
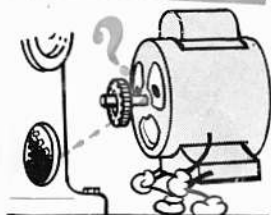
THERMAL OVERLOAD PROTECTOR

When a motor becomes overloaded, it meets the increased demand for power by drawing a higher amperage. This can go on until it is overloaded to the point of stalling — and it will then draw an excessive amperage, so much (in fact) that either the motor or the wires to it will burn up if this condition is not corrected. A fuse in the circuit to the motor will correct this condition, by "blowing" to open the circuit.

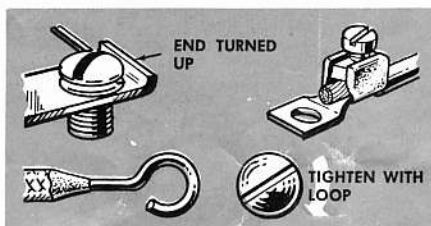
Some motors, however, have a built-in *thermal overload protector*, which acts like a fuse to open the circuit, but is more convenient. Two kinds are used: 1) *Automatic Reset* (which closes the circuit again when motor has cooled sufficiently); and 2) *Manual Reset* (which can be closed by hand when the motor is cool enough).

SPECIAL HOUSINGS

The average motor housing is built to provide good protection for the motor (from dust and dirt) under normal conditions of motor operation around a home, office or plant. However, special conditions must sometimes be met — as when a motor must run in the presence of explosive fumes (around a gasoline depot). Housings designed for every conceivable special condition are available — but, remember, you must order them specifically.



PROPER WIRING PROCEDURES



WIRE COVER COLORS

Properly, the white covered wire is always *neutral* (grounded). *Hot wire(s)* are always some other color (black, or if its a 3-wire system, black and red, etc.).

SCREW-TYPE TERMINALS

If a motor has one white terminal (the other(s) being copper), connect the white-covered wire to this white terminal. To connect wires, whittle the insulation away at an angle to leave about $\frac{3}{4}$ -inch of clean, bare wire. If wire is No. 8 or smaller, connect it by forming a loop to turn *with the screw*, as shown. If it is No. 6 or larger, either solder it to the terminal or use a solderless terminal (of type shown) and connect this to the motor terminal.

SOLDERLESS SPLICES

Wires No. 8 and smaller can be *spliced* (joined), as shown, with solderless connectors — if wires will *not* be under any strain. If under strain, wires should be soldered together. No. 6 and larger wires should be joined with metal connectors (of types shown).

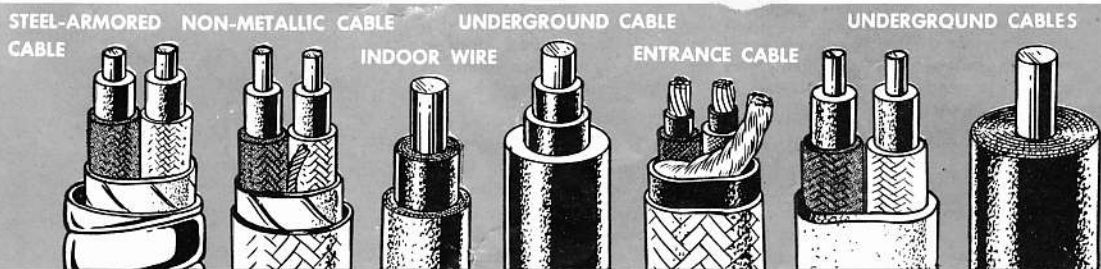
SOLDERED SPLICES

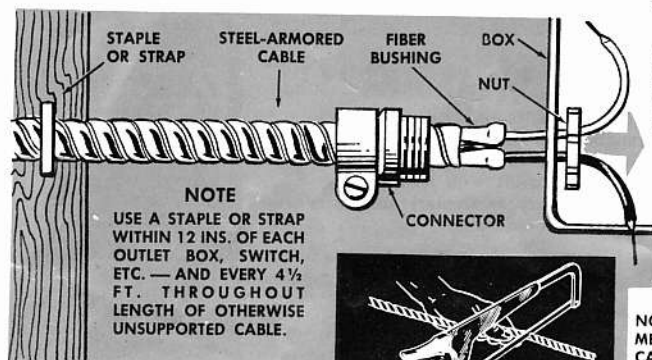
Good soldering is essential for a permanent connection that will not offer resistance to the "flow" of the current. Clean wires thoroughly. Twist them together as shown. Then heat the wire (*not the solder*) while touching solder to wire. This assures filling all the cracks with solder stuck to the wires. (A solder dipper, illustrated, saves time). Tape the splice, overlapping the wire covers at least $\frac{1}{4}$ inch, either with a double layer of plastic tape, or a layer of rubber tape topped with two layers of friction tape.

SELECTING WIRE

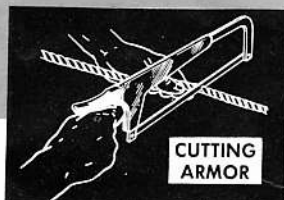
Typical wire types and their uses are illustrated. *Consult your local code.* Single (indoor) wire is cheapest to use, but most codes require this to be kept in the open (where it can be checked), or enclosed in metal conduit. Indoor cable is easier to install, and may be hidden inside walls. Entrance wire (from power lines into a building) usually must be in metal conduit. Some codes prohibit indoor wire (especially armored cable) in barns (where fumes deteriorate metal).

TYPES OF WIRE





ARMORED CABLE



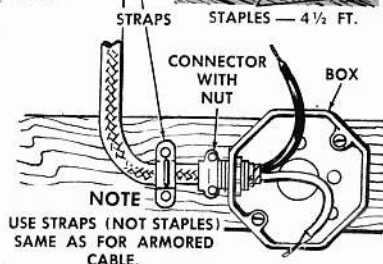
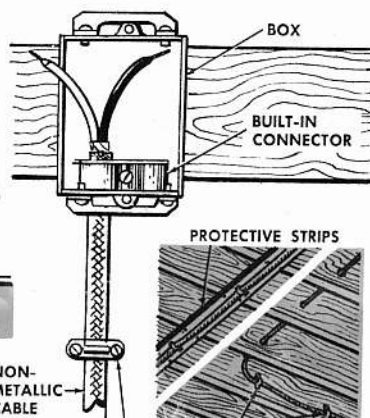
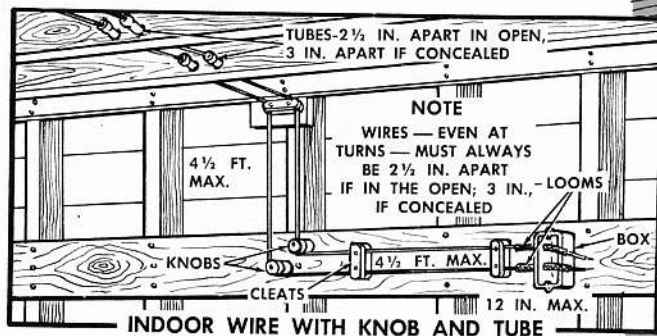
STRINGING WIRE

Always enclose splices (after taping) in *outlet boxes*. These are of various types — for hiding in a wall, or mounting in the open. When used only to enclose a splice, a *plain box cover* is used; but covers incorporating *plug outlets*, *switches*, etc. may be used. Some have *built-in connectors* (illustrated) to hold cable ends securely in the box. Others simply have knock-outs to provide holes, and *separate connectors* (illustrated) must be used to secure the cable ends. If single wire is used, the ends entering a box should be enclosed in *looms*.

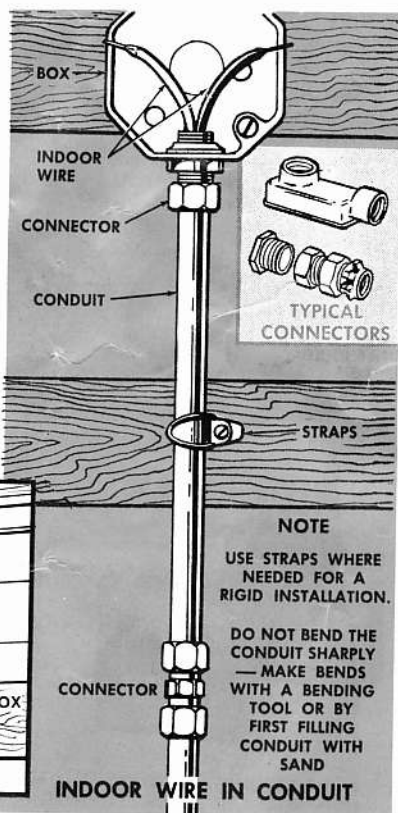
Codes require that cables or wires be supported. Typical requirements are illustrated. Cables may be strung through bored holes, but cannot be bent at sharp angles. Single wires are usually placed in *tubes* to pass through wood, etc. — and must be supported and properly spaced apart on *porcelain cleats* or *knobs*. Or they may be run through *metal conduit*. All wires or cables should be placed where they cannot suffer mechanical injury — should be protected (if necessary) by wood strips supported out from (not against) them.

Always mount switches and receptacles where they can conveniently be reached — without standing in water or on a damp or slippery surface. If exposed to weather, be sure to use approved outdoor types.

Sears Electrical Appliance Dept. offers a complete assortment of wires, accessories and electrical devices for every type of installation.



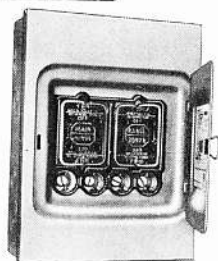
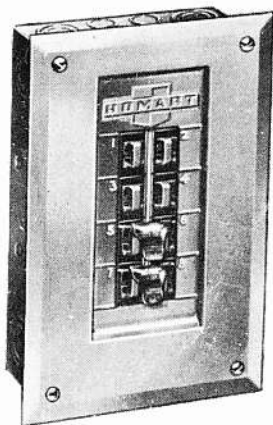
NON-METALLIC CABLE



Devices to AID YOUR INSTALLATION

ENTRANCE SWITCHES

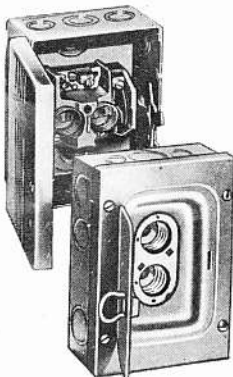
Both fused and fuseless types — sizes and circuit arrangements for every need. The fuseless types shown are fully magnetic (do *not* respond to heat or cold) with manual re-set buttons — will carry momentary overload caused by starting of a motor.



CIRCUIT-BREAKER SWITCHES INDOOR SAFETY SWITCHES FUSE CABINETS

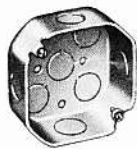
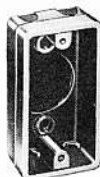
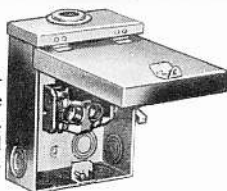
Thermal-type (heat-operated) circuit-breaker switches have manual re-set buttons and various (1 to 6) circuit arrangements like the entrance switches — some for 230 volts.

Safety switches (for convenient remote control of motor, etc.) are available with or without fuse sockets. Fuse cabinets (for separate fusing of motor circuit) are available with 2 to 8 circuits.



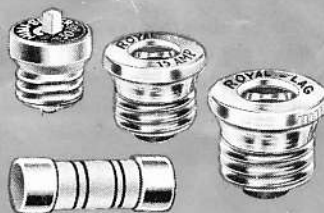
OUTLET BOXES

Steel boxes for flush or surface mounting and bakelite boxes for surface mounting. Covers with receptacles and switches of various types. Also outdoor boxes.



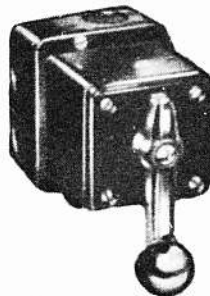
FUSES

Time-lag fuses provide best motor protection as you needn't allow "over-size" to carry the starting load. Cartridge fuses (for main lines) and standard types also available.



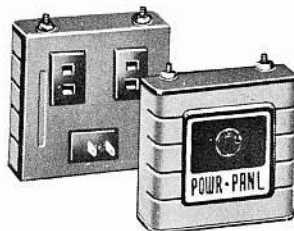
REVERSING SWITCH

Compact switch for reversing any Split-Phase or Capacitor-Type motor up to 1 HP. Connection diagrams with switch.



POWR-PANL

A safe, convenient, 2-plug receptacle with toggle switch — for motors up to 1 HP total for the two receptacles.



HOW TO INSTALL YOUR MOTOR

ELECTRICAL REQUIREMENTS

USE LARGE ENOUGH WIRE, SWITCHES, ETC.

Importance of "Safe" Size

All wires and electrical devices (switches, receptacles, etc.) are designed to carry up to a specified *load* (no. of amps). Overloads may: 1) Cause wires or devices to burn out — with danger of fire; 2) Cause excessive *voltage drop* (loss of voltage at motor) so that motor runs inefficiently, overheats, and could burn out. Voltage drop *should be held to 5% max.* for R-1 and 3-Phase motors; to 2% max. for all other motors.

Figuring Loads

For a motor, use the "Amps" shown on nameplate — *and add 30% for safety.* Other appliances are usually rated in *watts*. Amps = $\frac{\text{watts}}{\text{volts}}$ (i.e.: a 60

watt bulb on a 115V circuit = $\frac{60}{115} = 0.5$ amps).

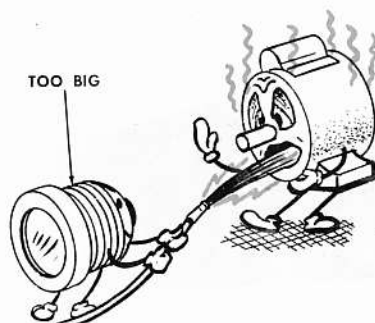
Selecting Devices and Wires

Devices are labeled in amps. Wires are rated by *diameters* with AWG (Am. Wire Gage) Nos.; by *type* (of covering); and by *length*. A wire may be just right to carry a certain load for (say) 50 ft; but not to carry it 100 ft. Reason: the longer a wire is the greater the voltage drop at its end.

WIRE LOAD RATINGS (IN AMPS) FOR 50 FT LENGTHS

Wire Size (AWG)	Armored or Non-Metallic Cable — or Indoor Wire in Conduit	Indoor Wire (Knob & Tube)	Outside Wiring (p. 9)
14	15	20	30
12	20	25	40
10	30	40	55
8	45	55	70
6	65	80	100
4	85	105	130
2	115	140	175
1	130	165	205
0	150	195	235

Ratings in table are for 50 ft lengths of 2-wire cable or extension cord — or 100 ft of single wire. Increase wire by one size for each added 50 (or 100) ft, or fraction thereof. Never use smaller than 14 wire — or ordinary extension cord — for permanent wiring.



USE A SMALL ENOUGH FUSE

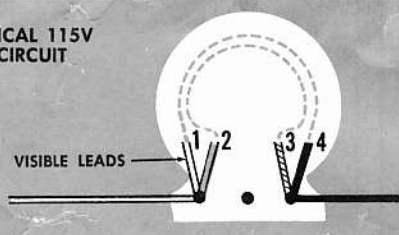
Every motor deserves the protection of an individual fuse or circuit breaker designed to "blow" before motor can be damaged. Because the starting amps required are much greater than the *normal running amps*, a standard fuse big enough not to blow every time motor starts is much too big to protect motor against burn out from continuous overloading. Therefore, *only a Time-Lag fuse* (p. 10) will protect your motor. Use one rated the same as the "Amps" on motor nameplate, plus *not more than 25%*. On 115/230V circuits, use 2 fuses; use 3 on a 3-phase circuit.

FUSES ARE CHEAPER THAN MOTORS!

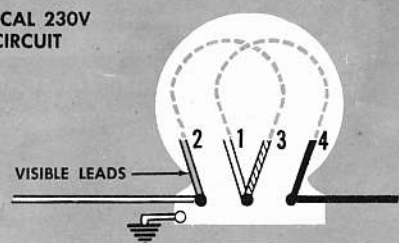
MAKING CONNECTIONS AT MOTOR

Your Sears' motor will have a cord and plug, or a conduit box with colored wire leads inside it. If there are leads, splice them (p. 8) to the circuit wires *according to wiring diagram on motor.*

TYPICAL 115V CIRCUIT



TYPICAL 230V CIRCUIT



CONNECTING TO AN EXISTING CIRCUIT

Before plugging-in or splicing a motor branch circuit to an existing circuit, check the wire (etc.) sizes — and check the load already on the circuit.

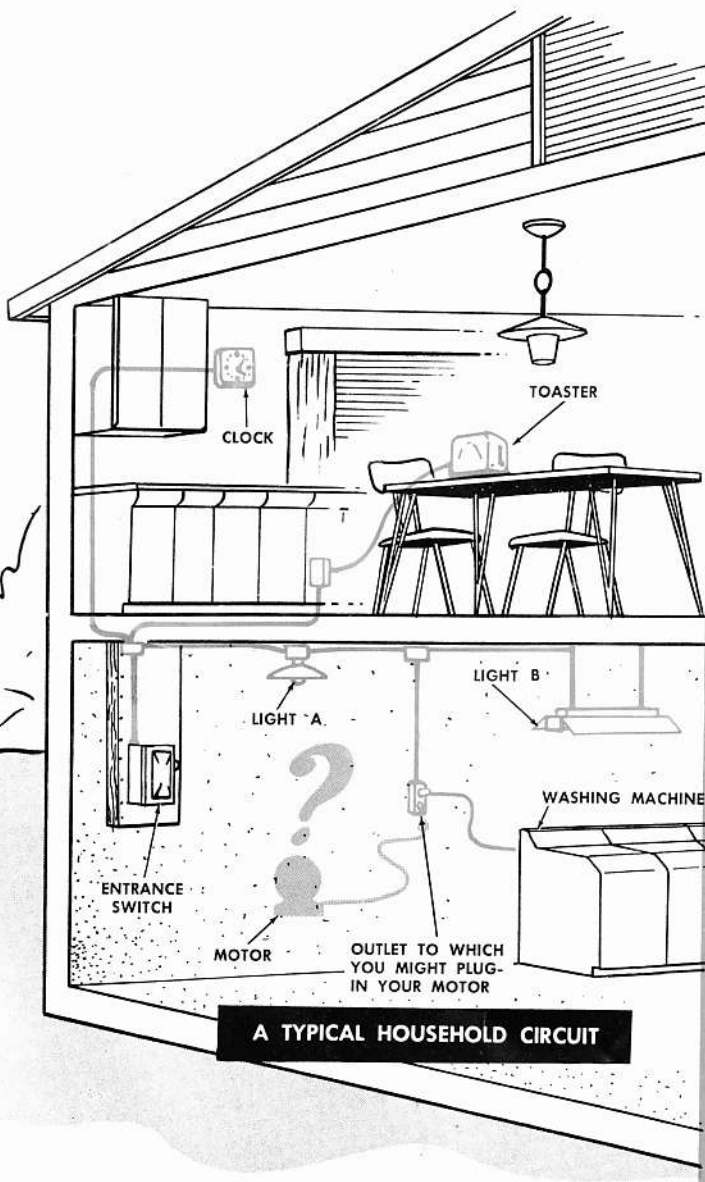
1. Some appliances will be OFF while others are ON. Just total the amps for those *which could be ON simultaneously*.

2. A $\frac{1}{4}$ or $\frac{1}{3}$ HP motor can generally be added to an average household circuit without overloading it — and a $\frac{1}{2}$ or $\frac{3}{4}$ HP motor probably can

if there are *no other motors or heating appliances* on the circuit. Larger motors usually require a separate circuit.

3. Open the circuit by removing the fuse (or fuses) which controls it.

4. If circuit has a standard fuse(s), substitute Time-Lag fuse(s), or install one in the separate line to motor — unless motor has built-in overload protection.



TOTALING THE WATTS FOR THE CIRCUIT SHOWN

ITEM	WATTS
Clock	0.50
Toaster	1100.00
Lamp A	100.00
Lamp B	40.00
Wash. Mach.	400.00
TOTAL	1640.50

AVERAGE RATINGS

APPLIANCES	WATTS
Clothes Dryer	1500-4500
Coal Stoker	300
Coffee Maker	650-1000
Dishwasher	300
Elec. Blanket	200
Fan-Table	75-150
-Ventilating	150-550
Fluores. Tubes	15-50
Food Mixer	150
Freezer (home)	350
Grill (large)	660-1000
Heater-Water	3000
-Room	1000 Up
Iron	1000
Ironer	1650
Light Bulbs	As Marked
Radio-Phono.	100
Range (kitchen)	7000-14000
Refrigerator	250
Roaster (large)	1650
Shaver	10
Stove (table)	1650
Television	500
Toaster (auto.)	1100
Vacuum Clnr.	400
Waffle Iron	660
Wash. Machine	350-450
Water Pump	300

1-PHASE AC MOTORS	NORMAL-RUN. AMPS	
	115V	230V
$\frac{1}{6}$	3.2	1.6
$\frac{1}{4}$	4.6	2.3
$\frac{1}{2}$	5.6	2.8
$\frac{3}{4}$	7.4	3.7
$1\frac{1}{2}$	10.2	5.1
1	13.0	6.5
$1\frac{1}{2}$	18.4	9.2
2	24.0	12.0
3	34.0	17.0
5	56.0	28.0

PROVIDING A NEW BRANCH CIRCUIT

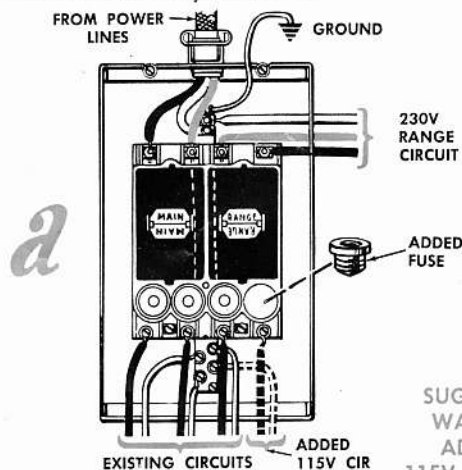
A new branch circuit is one *starting at your entrance switch* — and may be installed if switch has provision for an additional circuit. Just remember:

1. If spare terminals are exposed and you can connect to entrance switch without disassembling it, simply open the switch to simultaneously *shut off all house current*. If you must disassemble switch or touch any wire leading into it, first have Power Co. shut off your service.

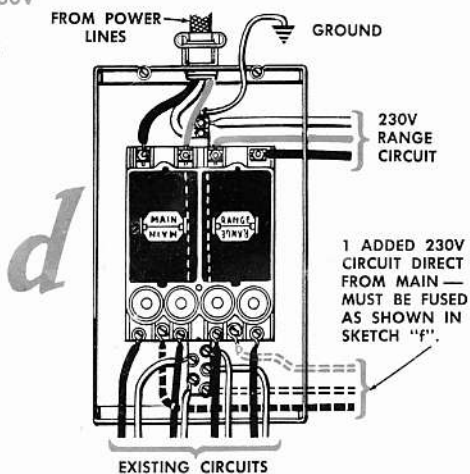
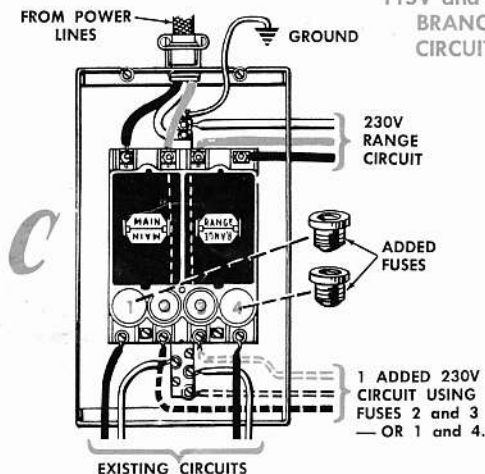
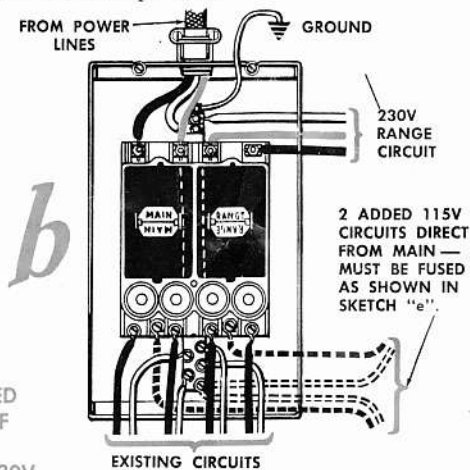
2. Complete the new wiring *before* connecting it to entrance switch.

3. Check to see that spare terminals in entrance switch are intended to carry load you will connect to them. Usually, fuse sizes are indicated on the switch cover — and you can tell from this.

4. If motor will operate* on 115/230V, choose 230V whenever possible.



SUGGESTED
WAYS OF
ADDING
115V and 230V
BRANCH
CIRCUITS

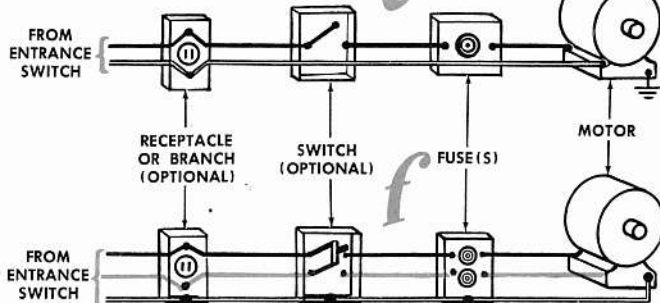


NOTES

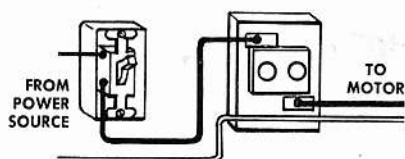
Fuses, as shown, must be used if connections at the entrance switch are made as in sketches "b" and "d" — otherwise, fuses are optional (but recommended if receptacles or branch lines are used as shown in sketches "e" and "f").

In a 230V circuit the white (neutral) wire should be grounded to each outlet box, switch box (etc.) — and to each motor housing, as shown. However, 2-wire circuits can be used (omitting neutral wire) if neutral wire is grounded at entrance switch — and if each box and motor housing is also properly grounded.

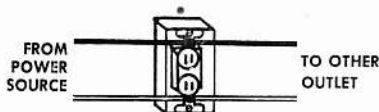
TYPICAL 115V BRANCH CIRCUITS



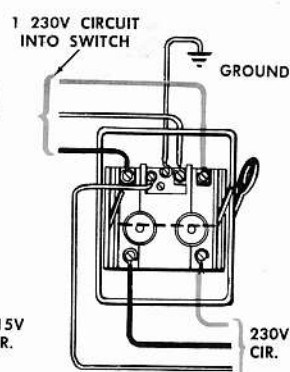
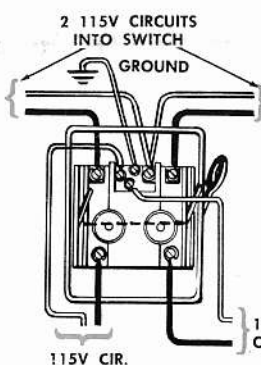
TYPICAL 230V BRANCH CIRCUITS



CONNECTIONS TO A SWITCH AND TO A FUSE CABINET



CONNECTIONS TO A RECEPTACLE



CONNECTIONS TO A SAFETY SWITCH (WITH FUSES)

PROVIDING A NEW MAIN CIRCUIT

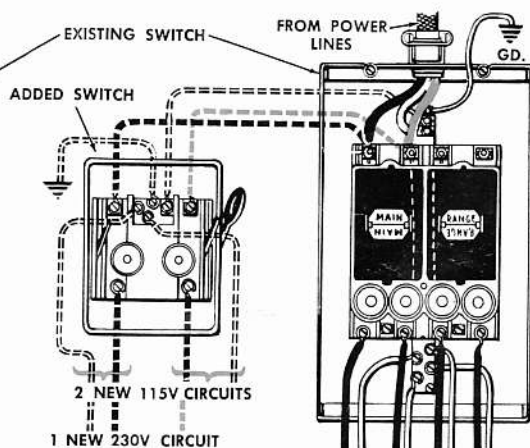
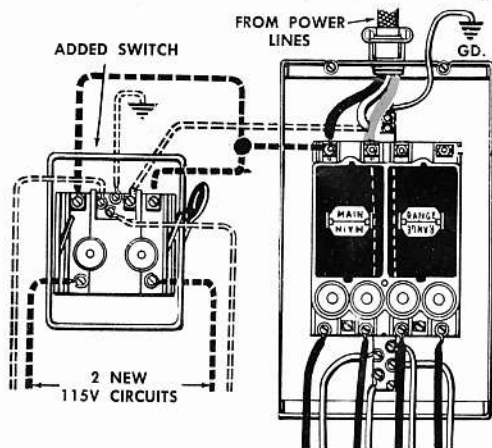
If the existing circuits and entrance switch are loaded to capacity — or if you need 230V and have only 115V — you will have to install a new service switch connected directly to the Power Co. lines.

1. Use any suitable size switch (p. 10) and mount this conveniently near the existing entrance switch. Complete all wiring from new switch to motor(s).

2. Have Power Co. connect new switch to their line — or have them *shut off the power* while you

make the connection.

3. If lines entering original switch are large enough (Power Co. will advise), you can connect new switch to these lines inside the original switch, as shown. Otherwise, you must provide new lead-in wiring to a Service Entrance Head (or Yard-pole, on a farm). Complete instructions are given in Sears' booklet "Electric Wiring for Home or Farm" on sale in our Elect. Appliances Dept. for a small sum.



SAFETY NOTES

Never work with existing wires or equipment without *first making certain power is OFF*.

Check local codes before buying wire or equipment — or doing any wiring.

Avoid long extension cords — they are subject to damage.

For wiring in barns (*where dampness and manure fumes rapidly deteriorate ordinary wires and metal*) we recommend use of our Single Wire

Trench Cable with Knob and Tube installation (p. 9), together with Bakelite Surface Wiring Devices (p. 10). Open wiring permits frequent inspection.

Never install devices where someone must stand in dampness or close to machinery to operate them.

In stringing long wires remember to *support weight of wire properly* — and *allow slack* to take up the contraction of wire in cold weather.

PHYSICAL MOUNTING REQUIREMENTS

PRE-MOUNTING CHECK

To check against shipping damage, rotate the shaft *with your fingers* — it should turn freely. Now operate the motor *without load* — it should run smoothly with a low electrical hum.

SELECTING LOCATION

Locate motor where it will be as *dry and cool* as possible. Do *not* expose it to weather, *nor* enclose it so that it doesn't get free air circulation. (Wire screens around a motor may become clogged and shut off circulation). Also, don't install it where possible sparks could ignite grain dust or similar inflammables — unless it is a special enclosed type.

MOUNTING

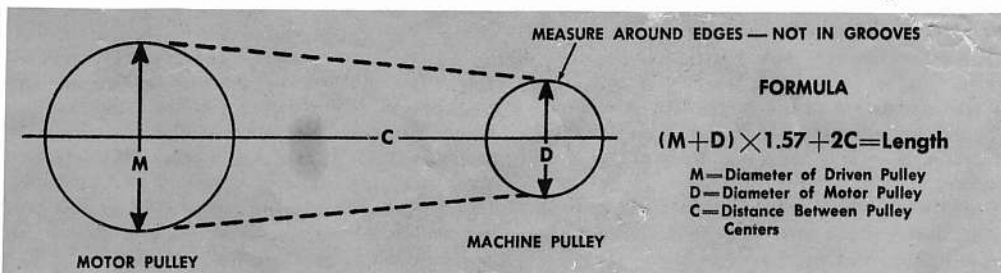
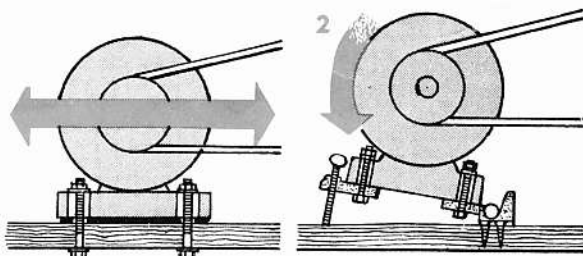
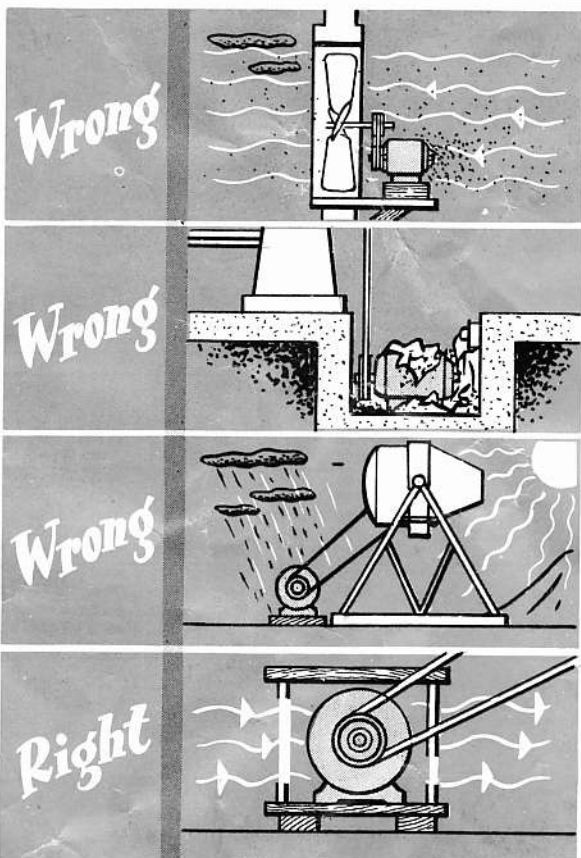
Bronze bearing motors *should be mounted horizontally* — to prevent the oil from draining out of the oil cups. Ball bearing motors may be mounted in any position.

If quiet operation is desired, motor may be mounted on rubber or spring cushions — but this will cause it to "float" and is not advisable when exact shaft alignment is required.

There are two methods of maintaining belt tension. 1) Use the motor base slots, and slide the motor to tighten the belt. 2) Use a *motor rail* as illustrated. In either case, make the retaining bolts secure.

MEASURING FOR V-BELTS

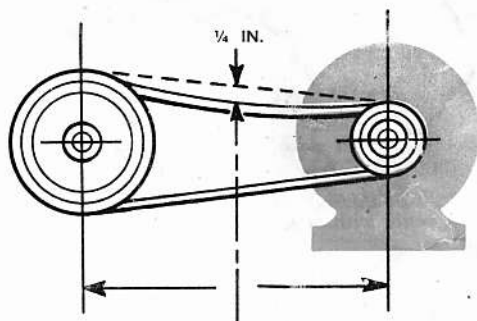
You can measure with string or tape around the outside edges (*not in the grooves*) of the motor pulley and driven pulley — to obtain belt length. Length can also be figured as shown in accompanying illustration.



A belt should be just tight enough so that finger pressure midway between pulleys will deflect it about 1/4 inch. If too loose, slippage of the pulleys will wear it out. If too tight, it increases motor load and wear on the bearings.

SELECTING PULLEYS

V-pulleys are measured from edge to edge (*not in groove*). The following table gives you the speeds of driven pulleys when using various combinations of drive and driven pulley sizes (in inches).



* DRIVEN PULLEY SPEEDS IN RPM

DIAM. MOTOR PULLEY	DIAMETER OF PULLEY ON MACHINE, INCHES														
	1 1/4	1 1/2	1 3/4	2	2 1/4	2 1/2	3	4	5	6 1/2	8	10	12	15	18
1 1/4	1725	1435	1230	1075	950	850	715	540	430	330	265	215	175	140	115
1 1/2	2075	1725	1475	1290	1140	1030	850	645	515	395	320	265	215	170	140
1 3/4	2400	2000	1725	1500	1340	1200	1000	750	600	460	375	315	250	200	165
2	2775	2290	1970	1725	1530	1375	1145	850	685	530	430	345	285	230	190
2 1/4	3100	2580	2200	1930	1725	1550	1290	965	775	595	485	385	325	255	215
2 1/2	3450	2870	2460	2150	1900	1725	1435	1075	850	660	540	430	355	285	240
3	4140	3450	2950	2580	2290	2070	1725	1290	1070	800	615	515	430	345	285
4	5500	4575	3950	3450	3060	2775	2295	1725	1375	1060	860	700	575	460	375
5	6850	5750	4920	4300	3825	3450	2865	2150	1725	1325	1075	860	715	575	475
6 1/2	8950	7475	6400	5600	4975	4480	3730	2790	2240	1725	1400	1120	930	745	620
8		9200	7870	6900	6125	5520	4600	3450	2750	2120	1725	1375	1140	915	765
10			9850	8620	7670	6900	5750	4300	3450	2650	2150	1725	1430	1140	950
12					9200	8280	6900	5160	4130	3180	2580	2075	1725	1375	1140
15							8635	6470	5170	3970	3230	2580	2150	1725	1425
18								7750	6200	4770	3880	3100	2580	2070	1725

* DRIVEN pulley speed based on use of a 1,725 rpm motor. For a 3,450 rpm motor double the speeds listed. The formula for figuring speeds is:

$$\frac{\text{Dia. of Drive Pulley}}{\text{Dia. of Driven Pulley}} = \frac{\text{Speed of Machine}}{\text{Speed of Motor}}$$

PRECAUTIONS THAT WILL SAVE YOUR MOTOR

DON'T OVERLOAD MOTOR

Overloading a motor can burn it out. *Don't expect it to run continuously overloaded.*

DON'T LET VOLTAGE DROP

When voltage at motor drops, exactly the same thing happens as when the motor is overloaded. With too little "fuel" it is (in effect) overworked — heats up — and will burn out. Use ample size wiring.

DON'T "SUFFOCATE" MOTOR

If free circulation of air to a motor is restricted (by dirt, rags or paper, or closing it up in a box) it overheats — may burn out. *Keep motor clean, and dry.*

If used where wood chips, dust, etc. can enter inside, blow out the interior with dry compressed air — or use a vacuum cleaner.

GROUND MOTOR PROPERLY

The motor frame should be connected, by wire of same size used in line to motor, to a suitable ground (water pipes or a grounding rod properly installed) — both to protect you, and to protect the motor in case of an internal short circuit.

LUBRICATE MOTOR PROPERLY

Motors with bronze bearings do require regular — *but not too frequent or excessive* — lubrication. It's best to check often and add a few drops each time. *Too much oil* can cause trouble by getting out of the bearing into the motor.

USE RE-SET PROPERLY

If you have an overload protector with a manual reset button, always *wait for motor to cool before* using the re-set. *Never* hammer the re-set (if it seems to "stick"), as this will break off the switch parts. Any trouble with re-setting will probably be due to dust between the contacts — and blowing away the dust, or simply holding the button in firmly, will correct this.